PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference KWN/739.01/W	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB2004/005116	International filing date *(day/month/year)* 06.12.2004	Priority date *(day/month/year)* 22.05.2004
International Patent Classification (IPC) or both national classification and IPC INV. B24B19/12 B24B41/04		
Applicant UNOVA U.K. LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16.08.2005	30.08.2006
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Koller, S Telephone No. +49 89 2399-2841

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB2004/005116

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-8 as originally filed

Claims, Numbers

1-12 as amended (together with any statement) under Art. 19 PCT

Drawings, Sheets

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-12
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-12
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document:
   D1: DE 196 35 687 A1 (SCHAUDT MASCHINENBAU GMBH, 70329 STUTTGART, DE) 5 March 1998 (1998-03-05)

2. **Claim 1**: The document **D1** is regarded as being the closest prior art to the subject-matter of claim 1 (device), and shows a spindle for a grinding wheel as defined in the pre-characterising portion of claim 1.

   The subject-matter of claim 1 differs from this known spindle mainly in the special arrangement of the three hydrostatic bearings as detailed in the characterising portion of claim 1.

   The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

   The problem to be solved by the present invention may be regarded as a spindle design, where resonance can be excited and spindle performance will be affected, often to the point of failure.

   The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: The hydrostatic bearings are disposed in such a way, that the weight of the electric motor and of the spindle itself does not lead to an interfering resonance, thus solving the posed problem.

3. **Claims 2-11** are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

4. **Claim 12**: The method of constructing such a spindle is considered as being new and inventive, since the product itself is already new and inventive.
   Nevertheless the steps to arrive at the product as claimed must be detailed by providing the necessary functional and structural features.

C739.01/W

CLAIMS

1. A spindle for a grinding wheel which is to grind re-entrant cams on camshafts comprising a shaft at one end of which is mounted the grinding wheel, drive means for driving the other end of the shaft, and a rigid elongate casing extending axially from the drive means and encasing the shaft, characterised in that the drive means is an electric motor, and in that the length of the shaft and casing is selected to be at least as long as the axial length of a camshaft to be ground by the wheel, the shaft being carried in three hydrostatic bearings, one of which is located near said one end of the shaft so as to be at the end of the rigid casing remote from the motor, thereby to increase the shaft stiffness and increase its resistance to bending, the two other bearings disposed on opposite sides of the motor.

2. A spindle as claimed in claim 1 wherein the second bearing is located at the inboard end of the external part of the shaft, and the third bearing is located within the motor at said other end of the shaft.

3. A spindle as claimed in claim 1 or claim 2 wherein the stator of the motor is secured within a rigid housing and the non-rotating element of each of the three bearings is secured within either the rigid elongate casing or the rigid motor housing.

4. A spindle as claimed in claim 2 or claim 3 wherein the axial length of the part of the shaft which carries the rotor of the motor is shorter than the external part of the shaft, the shaft being constructed so that the stiffness and the support of the shorter part of the shaft situated between the second and third bearings dictate that the bending resonance of the longer external part is above the critical spindle rotational frequency.

5. A spindle as claimed in any one of claims 1 to 4 in which a symmetrical design of housing is employed for the motor.

6. A spindle as claimed in claim 5 wherein the motor housing includes a water cooling jacket in which water is forced to follow a helical path around the motor, so as to avoid cooling one side of the motor more than another.

7. A spindle as claimed in any one of claims 1 to 6 wherein the spindle is constructed to be axisymmetrical, so that any heat generated within the bearings dissipates radially into the surrounding material in a uniform manner, so that in use the spindle casing will tend to warm up and cool down uniformly, and therefore expand and contract uniformly.

8. A spindle as claimed in any one of claims 1 to 7 in which, in use, oil is supplied under pressure to the bearings by a pump which draws oil from a reservoir to which oil returns from the bearings.

9. A spindle as claimed in claim 8 comprising an enclosure formed by the rigid casing and a housing for the motor, wherein oil heated in use in each bearing drains into the lower regions of the enclosure and can thereby become heated to a higher temperature then the upper regions thereof.

10. A spindle as claimed in claim 9 wherein the lower regions of the enclosure are formed as a separate oil collection box which is mounted to the remainder of the enclosure in such a manner that it will not impart a strain on the spindle shaft.

11. A spindle as claimed in claim 9 or claim 10 wherein a thermal barrier is provided between the said lower regions and the remainder of the enclosure to reduce the transfer of heat from the hot oil to the upper regions of the enclosure and thereby prevent thermally induced misalignment of the three bearings and any strain on the spindle shaft caused by any such misalignment.

12. A method of constructing a spindle as claimed in claim 2 wherein during assembly the internal bores of two of the bearings are initially aligned and the third bearing is adjusted radially to bring all three bores into alignment.